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RESEARCH REPORT

DRIVERS OF COST SYSTEM DEVELOPMENT IN HOSPITALS: RESULTS OF A SURVEY

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Drivers of cost system development in hospitals:

Results of a survey

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Abstract

While many hospitals are under pressure to become more cost efficient, new costing systems such as Activity-based costing (ABC) may form a solution. However, the factors that may facilitate (or inhibit) cost system changes towards ABC have not yet been disentangled in a specific hospital context. Via a survey study of hospitals, we discovered that cost system development in hospitals could largely be explained by hospital specific factors. Issues such as the support of the medical parties towards cost system use, the awareness of problems with the existing legal cost system, the way hospitals and physicians arrange reimbursements, should be considered if hospitals refine their cost system. Conversely, ABC-adoption issues that were found to be crucial in other industries are less important. Apparently, installing a cost system requires a different approach in hospital settings. Especially, results suggest that hospital management should not underestimate the interest of the physician in the process of redesigning cost systems.

Keywords: Activity Based Costing, Organizational Change, Cost Control, Hospital context

1. Introduction

With margins on the decline, more restrictive reimbursement schemes based on diagnostic-related groups (DRGs), increasing complexity and rising costs, the health care sector faces a new challenge of becoming more cost efficient to survive in this changing environment [1, 2, 3]. More developed cost systems such as Activity Based Costing (ABC), may facilitate this strive for cost efficiency. ABC provides more detailed cost information on the activities of the hospital, which could typically result in better cost reduction and cost management [4, 5]. In other industries, it has proven to be successful since firms that extensively use ABC outperform similar matched firms that do not adopt ABC, mainly through more efficient cost control efforts [6, 7]. However, while there are different levels of cost system design, it seems remarkable that the number of hospitals collecting cost on a more detailed basis remains limited [2]. Relative to other industries, the health care sector still lags behind [8]. The reason for this discrepancy has hardly ever been investigated. The main contribution of the present study is that it provides an insight in the factors that in fact drive (or inhibit) further cost system development in the health care sector. Via this insight, management may better understand the crucial factors for promoting cost system improvement in a health care environment.

As a starting point we look at ABC-adoption in other industries. We will test whether the few existing factors known to be associated with the adoption of more accurate costing systems in these industries, are applicable for the health care sector [9, 10, 11]. Secondly, it is important to note that the present study takes the specific behavioral and organizational factors of the sector into account [12]. Unlike manufacturing companies, health care providers in many countries are for refunding

purposes legally required to allocate costs in a predefined manner e.g. Medicare Cost System in the US, [13]. Hospitals may find this legal cost system sufficient and hence more refined costing methods such as activity-based costing may not be considered. Important powerful coalitions [12] such as the physicians may have a stake in whether the cost system is further developed. Thirdly, this study further recognizes that implementing cost system refinements in hospitals typically requires progress in stages before full adoption is achieved [2, 11].

The results of our survey, conducted in the hospital sector, show that cost system improvement in hospitals, is largely determined by health care specific factors such as the dissatisfaction with the legal system, the support of medical staff to cost system use, the way the reimbursements between hospitals and their physicians are arranged etc... This seems to suggest that health care management should focus on hospital specific elements in order to facilitate ABC adoption. Factors observed in other industries have less explanatory power and as such they may be less crucial for further promoting cost system change.

2. Literature Review

In many countries hospitals are legally required for refunding purposes to have a predefined cost allocation scheme [13, 14]. This makes them unique to other industries where such a legal obligation does not exist. The legal system mostly takes the form of a step-down allocation of costs from service departments (e.g. administration, cafeteria, laundry, etc.) to revenue generating departments such as acute care, surgery, laboratory. Sometimes cost are further allocated down to patient-level. Often the legal system uses a large set of pre-defined cost drivers (See U.S.

Medicare cost report in Eldenburg and Kallapur [13], [15]). While such legal systems are quite elaborated, it does not preclude management from adjusting the cost system to make it more relevant for their internal decisions [15, 16]. Rather than immediately installing ABC, hospitals tend to change gradually towards ABC. They often start by adjusting their existing legal system or they may first thoroughly consider ABC [2, 9, 17]. In that respect, hospitals seem to adhere similar implementation stages as other industries [11, 18].

Our goal is to disentangle different levels of cost system design and the drivers in a health care setting that explain this process of changing to ABC. To our knowledge, evidence on this matter remains very scarce. As a first step we look at general drivers of ABC-adoption from other industries. Next, we discuss several elements from our own review of the health care sector that may drive (or inhibit) cost system change. Finally, we provide specific control variables for the level of cost system in a health care setting. Table 1 summarizes the drivers we identified and their expected direction on cost system development. The next sections further explain these issues.

[Insert Table 1 about here]

2.1. General drivers of cost system development

There only exist a limited number of studies that identified some general drivers of cost system improvement for firms in other industries. Below we provide more detail on those general drivers that are expected to be relevant for a hospital setting.

Cost variability. Firms with a higher level of indirect overhead and greater heterogeneity in the way products make use of the firm's resources, are expected to introduce more refined costing systems [9,11, 19]. This issue may play a role in a

hospital context. Hospitals are often known as settings with many indirect cost categories and they treat various patients via divergent care processes that often consume overhead differently [17].

Cost importance. This issue mainly captures the way firms in other industries perceive cost data as crucial for their decisions and their competitive position [20, 21]. Given the current pressure on margins, this issue may especially apply to hospitals. We predict that the stronger the importance attached to cost data, the more likely that a hospital will adapts its cost system.

Quality link. Firms that focus on quality often link their formal quality programs with more accurate ABC-systems [10]. Similar considerations coexist in health care. Hospitals initiating programs to improve the quality of the care processes may be more in need of a cost system that accurately captures the cost of these different care process [4, 17].

System State. This issue concerns the general elaboration of the IT-system within a firm. The more elaborated and integrated the system and the more performance measures it gathers, the easier it is to introduce ABC-systems that make use of IT-systems and their information [22]. However, given that systems in health care often are designed to only fulfil legal requirements [15], the culture and the resources for hospital systems to integrate different applications and to issue performance information may not yet be well established [2].

Perceived complexity. This issue in fact captures whether the firm's operational environment is perceived as complex. Arguments in other industries seem to suggest that complex-dynamic organizations may especially benefit more from more accurate cost systems [23, 24]. This seems true for complex organizations such as hospitals that often treat highly complex care processes [3]. However, the perceived complexity

might obstruct cost system improvement, since the ABC problem requires very specific data from these complex processes which may be too difficult to obtain in hospital settings [5].

2.2. Hospital specific elements in cost system development

Hospitals have some unique features that are typically not observed in other industries [25]. An important contribution is that our study is one of the few to discuss the link of some of these features with the level of cost system design in hospital settings. Below we give an overview of these hospital specific elements.

Satisfaction legal system. As already mentioned, hospitals are legally required to use a predefined cost allocation scheme. This unique setting allows us to test to which extent hospitals are satisfied with this system. Due to the level of detail, satisfaction may be high such that hospitals may not screen other cost system options [26]. Conversely, criticisms as that the legal system would still produce unreliable cost estimates may initiate cost system change [16].

Use legal system. This factor can be perceived as slightly different from the previous one. While being unsatisfied about the legal system, hospitals may still consider the system sufficient and consequently use it for their decisions. However if management questions the usefulness of these figures [15] hospitals may be more likely to change towards refined costing such as ABC.

Organizational support. This aspect captures the organizational support towards cost system use. While cost innovations in other industries flow from top management support [12], hospitals are further unique in a sense that they have to work with physicians that are implicitly contracted without being employed for the hospital

[25, 27]. As physicians are responsible for a large part of the health care expenditures [28], their support towards cost control in general may be important for further cost system enhancement. Besides management and physicians, the support of the heads of various nursing departments is an additional factor that should not be overlooked. In sum, hospitals may be further evolved on the spectrum of cost system design when different organizational members support cost control.

Management-physician conflict. In hospitals, physicians often perceive cost control as very different from management. Physicians dictate that the provider-patient relationship is quite unique and do not want to give up the freedom to deploy as much resources as needed for the specific care of a patient [29]. This often does not stroke with ideas of central management that needs to plan resources for the hospital as a whole [30]. It has been shown that potential conflict between parties can arise that may hamper any innovation, such as cost system improvements [25, 31]. Such conflict is even more likely if physicians feel that they are controlled by central management. This is especially true if cost allocations are only used for assessing (controlling) financial arrangements between physicians and hospitals [32]. Our study assesses the level of conflict (directly by asking management to asses whether relations with their physicians are optimal or not, and indirectly by asking the degree of control through cost system use) as a factor that may drive or inhibit cost system change in hospitals. Cost system improvements such as ABC are more likely when relations with physicians are less conflicting or in other words more optimal.

Method of reimbursement. Reimbursement of health care providers (e.g. hospitals, physicians) by health care payers (e.g. governments, insurers) typically consists of financial flows for the *operational cost of the hospital* and *physician labor* [13, 33]. In many countries financial flows are centrally collected by one party (mostly the

hospital) who than agrees with the other party on how to split these flows between the hospital and the physician. To this end, several schemes exist that can either be classified as *retrospective*, in which the physician receives his fee minus a payment on the basis of the own costs he incurs (physician cost based), or as *prospective* in which physicians receive a fixed 'percentage' of the total revenues or financial surpluses (profit) of the hospital [34].

The reimbursement scheme may have an effect on the level of cost system design. If they remain physician cost based (retrospective), payments are based on the indirect overhead assigned to a specific physician [33, 34]. Management may then not be very motivated to control costs, because physicians simply pay back most of the hospital costs. In addition physicians may prefer a pre-defined legal cost system, as they may fear that new cost systems give management more discretion to maximize the financial streams for the hospital [13, 35]. New ABC systems, may lead to endless debates between hospitals and physicians over the specific assignment of overhead costs, which may hamper any cost system change [14]. Conversely under prospective systems, payments are at least not physician cost based. Furthermore, if payment is based on surplus (profit) rather than on total revenues this may create some incentives for cost control and as such there may be a need for ABC [36].

2.3. Specific control variables

Prior work suggests a positive relation between firm size and the level of ABC-adoption [9, 10, 11] did not find such an effect. Evidence in the health care sector suggests that larger hospitals in terms of bed size more extensively use their cost system [2]. We therefore take 'Bedsize' as a first potential control variable of the

level of cost system development. As a second control variable we check whether hospitals are involved in a merger. Those hospitals that struggle for survival are often restructuring their operations via mergers and therefore limited resources are not spent on improving the cost systems [2]. Mergers take up most of the time and cost system improvements are probably postponed until the merger is completed.

3. Research Method

3.1. Research Sample

The survey was conducted on a sample of hospitals, located in Flemish part of Belgium. Similar to most other countries, all hospitals in our sample are required to issue a legal cost report based on an elaborated set of drivers in a step-down allocation scheme from service to revenue generating departments. In addition, these hospitals also agree on various reimbursement schemes with their physicians. A total of 120 questionnaires were issued to either general hospitals, academic hospitals, psychiatric hospitals or specialized hospitals. The survey administered questions to identify the stage of cost system development and the hospital specific and general drivers that are possibly linked with the level of cost system design (sections 3.2 and 3.3 give more detail about the survey items). The survey was either addressed to the chief executive officer of the hospital facilities or the chief of the administration and financial department. These respondents are most likely to be informed about the design and the use of cost systems in their hospital.

Of the 120 questionnaires, we received 50 valid responses. This corresponds to a response rate of about 42%. Of the 50 valid replies, 48% came from general private

hospitals, 10% from general public hospitals, 38% from psychiatric facilities and the remaining 4% from either academic or specialized private hospitals. It is important to note that the sample's distribution is not significantly different from the distribution within the total population of 120 Flemish hospitals (Chi-square: 2.3; $p = 0.13$). In terms of size our sample counted 20% small facilities with less then 200 beds, 56% intermediate-sized hospitals with 200 to 499 beds and 24% large hospitals with over 500 beds.

3.2. Dependent variable

The primary dependent variable for our study is the stage of cost system development. Via our survey study we were able to identify three possible levels of cost system design. A first group of hospitals only installed the legal system. A second group of hospitals is in the process of changing their cost system. Either they started with small adjustments to their legal system by introducing more specific drivers and cost objects (e.g. patient-levels, DRG-levels) or they were in the process of considering ABC [2, 9]. This group may be situated on a sort of 'intermediate level' in the process of change towards more refined costing systems. The last group is on a more advanced level of cost system refinement. They actually indicated to be experimenting with ABC (Cfr. adoption phase; [11]) and as a result of this exercise they developed an adapted cost system. Table 2 shows how the sample of 50 hospitals is distributed across these three possible development stages of cost system design. One should further note that hospitals in phase 1 are somehow distinct from the two other groups. Unlike hospitals in phase 2 and 3, these hospitals do nothing in terms of

cost system refinement. In the result section, we report an additional model based on this dichotomy.

[Insert Table 2 about here]

3.2. Independent variables

The general drivers and most of the hospital specific elements, except for the type of reimbursement scheme, were measured via multiple (e.g. two or more) items that were in fact based on our arguments of the literature review. Appendix A displays the set of items issued. Respondents indicated the relevance for each item on a five-point Likert-scale (1= strongly disagree; 5= strongly agree). A first set contains items for the general drivers such as cost variability, cost importance, quality link, system state and perceived complexity. The next set focuses on the remaining hospital specific issues such as organizational support, satisfaction with and the use of the legal system and the level of conflict between management and physicians. We preferred multiple items because they capture more of a construct than single items [1, 37]. However to test whether our items actually capture the presumed construct, factor analyses were performed on both the sets of general drivers and hospital specific factors. The results of these factor analyses are displayed in panel A of table 3. Results show that the derived factors correspond closely to the constructs of the literature review, save for a few exceptions that will be discussed below.

Regarding the general drivers, it is important to note that the construct cost variability and cost importance form one factor "Cost_var". Apparently greater cost variability is a synonym for more importance attached to cost data. All items of the

second factor "Syst_state" indeed relate to the state of IT-systems in the hospital. The third factor "Complexity" forms the construct for the perceived complexity of the hospital processes and the cost allocation. Finally, we mention that our last factor does only partially captures our construct for the link of the cost system with quality. It only loads high on the quality item F (Table A1 in Appendix A). However, this last factor has also high loadings on item G measuring the extent to which systems generate various performance measures. We label this factor "Perf_link" as the degree of focus on performance measures in a hospital. Shields [12] suggests that this issue may indeed be relevant if ABC adoptions want to succeed. Analysis on the hospital specific items resulted in four factors with main items that indeed correspond to the presumed construct. Only the second factor related to organizational support does not load high on management support (Item L), suggesting that the views of management on cost control are divergent from the views of the medical staff. We label this factor "supp_med" as the support of medical parties towards cost control. The other factors are labeled as "sat_legal", "use_legal" and "conflict" according to their construct.

Similar as to Krumwiede [11, p. 249-250] we want use the factors as independent variables for explaining the level of cost system design (section 3.1) To this end, we calculated for each hospital a composite score for the derived factors. A composite factor score is an *aggregated score* of responses giving the most weight to items that load high on that specific factor. On average, they have a mean of zero and a standard deviation of 1 and correlations between factors approximate to zero. Alpha levels on the main items indicate that factors appear to be reliable and reasonably valid.

Finally, the remaining three independent variables, that is the hospital specific factor for the type of reimbursement and our two control variables, were measured directly via a single question. These variables are summarized in panel B of table 3.

The variable "Reimbursement" was based on a dummy. It is derived from the question in which respondents indicated whether the reimbursement scheme was based on physician specific cost elements such as actual cost or actual cost plus mark-up (Reimburse= retrospective) or on a fixed percentage of revenues or hospital surpluses (Reimburse= prospective). Next, the number of beds for each hospital facility represented our first control variable "Size" while our second control variable "Merger" is a zero vs. one variable (dummy) depending on whether or not a hospital indicated to be highly involved in restructuring its operations (e.g. merger).

[Insert Table 3 about here]

4. Empirical findings

We in fact performed two analyses. The first section uses the three levels of Table 2 as the dependent variable. In this way we can derive the factors that significantly differentiate between the various stages of cost system design, that is the drivers of cost system refinement. In the next section we study the dichotomy of hospitals that do not perform any cost system refinement (minimum level) versus all others that change. This analysis should shed light on the first initiators of cost system change.

4.1. Drivers of cost system development

Because of the specific order in the level of cost system design, an ordered logistic regression is actually the most appropriate method for this analysis. Hospitals on an advanced level (level 3) are further on the spectrum of cost system design than

hospitals in the process of change (level 2) or those that only have a legal system (level 1). Model 1 in Panel B of Table 4 reports the results of this regression.

When studying the general drivers, we only observe a significant positive effect of the variable 'cost_var'. Apparently hospitals that perceive high variability in costs and that attach high importance to cost in general are more likely to adjust their cost system in the direction of ABC. Summary statistics in Panel A of Table 4 show that especially the hospitals that have changed their system as a result of ABC-adoption (advanced), seem to find this issue much more important (higher factor score) than those hospitals that are in the process of changing or that only have a legal system. The state of IT-systems, the perceived complexity and the link with performance (including quality) do not drive or inhibit cost system change in a hospital setting.

Regarding the hospital specific elements, we observe more significant effects. First of all, 'satisfaction with the legal system' is significant and has a negative sign (model 1 in panel B). From panel A we can argue that hospitals that are less satisfied with the legal system are more likely to change or to install ABC (level 2 and 3) compared to their counterparts that only use a legal system (level 1). Although the system is quite elaborated, some Belgian hospitals seem to be unsatisfied as a result of perceived shortcomings to the legal system [15, 16] and consequently these hospitals are more likely to improve their cost system.

Panel A and Model 1 in Panel B further suggest that high support of the medical team towards cost control (Supp_med) is a factor that significantly differentiates among the different stages of cost system design. Unlike in other firms where cost system changes go through top management [12] our results point out that physicians, medical boards and heads of nursing departments seem to be powerful coalitions that may further stimulate changes towards ABC in hospital settings.

As suggested in our literature review, the reimbursement scheme is significant. Evidently, when reimbursements are physician cost based (retrospective) rather then prospective (e.g. fixed percentage of revenues or surplus), hospitals are less likely to change to ABC. Panel A indeed shows that none of the respondents in phase 3 had a reimbursement scheme based on physician costs (retrospective), while there are still a large number of users of retrospective schemes in phase 2 (45,8%) and phase 1 (55,0%). Under retrospective systems, physicians may fear that hospitals will use cost system changes to alter the cost-based amount physicians have to refund [36]. At least prospective schemes are not based on cost allocations and if they further use a fixed percent of hospital surpluses (instead of revenues), they may stimulate a need for better cost control in order to increase the hospital surplus.

Our two remaining hospital specific factors 'conflict management-physician' and 'use legal system' do not seem to differentiate among the different development stages. However, not only arguments of our literature review but also evidence from correlation tests[1] allude to a possible link of the reimbursement scheme with these two variables. When reimbursements are based on cost allocations (retrospective), there is more conflict between management and physicians probably resulting from debates over which cost to include in the analysis. Secondly, a likely explanation why retrospective systems may be linked to higher use of the legal system is that physicians may prefer (or force) the legal system for cost reimbursements. Unlike with new cost allocations where management may change allocation bases to maximize financial streams for the hospital [13], the legal system uses at least pre-defined cost allocation bases, so that hospital management has less discretion to maximize cost reimbursements emanating from the physician.

[1] Correlations of conflict and reimbursement (r: -0.367; p: .009) suggest that relations with physicians are less optimal when reimbursements are retrospective. In addition legal systems are also used more when reimbursement is physician cost based, though this correlation is weaker (r: 0.262; p: .066).

Due to these interactions, possible effects of 'use_legal' and 'conflict' may not be observed in model 1. We therefore ran model 2 in which reimbursement was left out the regression. Results show that 'conflict' and 'use_legal' become significant. In sum this hints that cost system changes are more likely when there is little conflict between management and physicians and when legal systems are considered as less useful for decision-making, which may in turn be driven by the type of reimbursement scheme.

Finally, our variables do not load significantly in both our two models. Apparently the hospital's size and its involvement in mergers do not differentiate between the different development stages that our survey identified[2].

[Insert Table 4 about here]

4.2. Minimum level vs. the changers

To single out the first initiators of change, we perform a binary logistic regression of those hospitals that do not change (Minimum: level 1) vs. all others that change (level 2 and 3 are taken together). Results are reported in model 3 and 4 of Table 4 and are similar to the models reported earlier, except for the fact that 'Cost_var' is not significant anymore. The models suggest that the hospital specific factors such as the satisfaction with the legal system, the support of medical parties and the method of reimbursement (and climate if reimbursement is left out of the analysis) serve as the first initiators of change. 'Cost_var' a general driver becomes only important in later stages if we recognize the difference in intermediate level and advanced level (models 1 and 2), but not in the current analysis. Summary statistics indeed confirm that this general driver especially matters at the more advanced level of cost system design.

[2] Other measures for size, e.g. the number of full-time employees, were also not significant.

4.3. Implications of the results

Hospitals tend to follow similar stages of cost system refinement as other industries. Our results however suggest that hospitals should *stimulate health care specific issues* rather than the general drivers of other industries. Only the level of cost variability and cost importance as a general driver is important only at more advanced levels of ABC adoption. Hospital specific issues in fact serve as initiators of change towards ABC. Especially the support of the medical staff should be considered if hospitals refine their cost system. Other measures such as the awareness of limitations of the legal system can further initiate cost system change. Of special interest is that management may need to revise the method of reimbursements between hospitals and physicians in order to ease ABC-adoption. If reimbursements remain physician cost based ABC adoption is difficult; cost system change may then further be precluded because of more conflicts and greater use of the legal system.

5. Discussion

As hospitals' income is under pressure as a result of rising health care costs and more restrictive budget constraints, hospitals are looking for options to become more cost efficient. For assisting their strive for cost efficiency, health care organizations may want to adopt more refined costing techniques, such as activity based costing (ABC) as they have proven to be successful in other industries [6]. However the factors that facilitate (or inhibit) this change towards ABC have not yet been investigated in hospital settings. Via a survey we single out factors that explain further cost system development in a health care context. First of all, the survey shows that

similar to other industries cost system change in hospitals gradually happens in different stages. However and more importantly, results indicate that the general drivers of ABC adoption from other industries are less crucial for promoting cost system change in hospitals. Apparently, typical features of the health care sector such as the satisfaction with and the use of the existing legal system, the support of the medical team, the level of conflict with and the way in which physicians are reimbursed seem to explain variations in cost system development among hospitals.

Hospitals are quite unique settings in a sense that they have to work with highly autonomous groups of physicians [25, 27]. While cost system changes normally flow from top management [12], our results suggest that in hospitals physicians and other medical parties are apparently powerful coalitions when it comes to redesigning cost systems. Not only the support of the medical team towards cost system change, but also a minimal level of conflict with the physician, make cost system change towards ABC more likely. The way hospitals arrange their reimbursement with the physicians may also require reassessment. If refunds depend on cost allocations, there may be endless debates over which cost to include in the analysis. Furthermore, physicians are not likely to go along with cost system changes as new cost systems such as ABC may give hospitals more discretion to maximize the cost reimbursement streams from the physician. Conversely changing to ABC is easier if reimbursements are not physician cost based. In sum, it is important for hospitals to consider the stakes of the physician and their support towards cost systems in the process of cost system refinement.

The fact that specific issues of the sector are more crucial for promoting cost system change may explain why hospitals typically lag behind other firms. Installing ABC apparently requires a different approach in hospitals. For example, the change of

attitude of the physician, installing new reimbursement schemes may require time that can slow down the process of changing towards ABC. We however do not depict factors of other industries as not important. Hospital specific factors may be the first steps of cost system change, while general drivers may become highly important in later stages (e.g. this applied to a certain extent for the general driver cost variability). The quality of IT-systems, top management support, the link with performance and quality measures, the perceived complexity may all be crucial factors in the process of ABC to grow to a fully operational system. Unfortunately, we only had a limited number of hospitals that adapted their cost system via ABC. Therefore, it is difficult to recognize further divisions in the type and the level of ABC-systems within this group. We however leave this fascinating conjecture for future research.

Appendix A

[Insert Table A1 about here]

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Table 1.
Relevant issues in cost system development

General drivers	**Hospital specific issues**	**Control variables**
Cost variability (+)	Satisfaction legal system (-)	Hospital size (+)
Cost importance (+)	Use legal system (-)	Involved in merger (-)
Quality link (+)	Organizational support (+)	
System state (+/-)	Management-physician conflict	
Perceived complexity (+/-)	(+ if less conflict)	
	Reimbursement (retrospective, -)	

Table 2
The different phases of cost system development identified by the survey

Phases of cost system development	**Number of Hospitals**	**Percentage**
1. *Minimum*: Only the legal system	20	40%
2. *Intermediate*: Process of changing the cost system	24	48%
3. *Advanced*: Adapted cost system as result of ABC adoption	6	12%
Total	50	100%

Table 3
Definitions of the independent variables

PANEL A: Independent variables as a result of a factor analysis [a]

Variable	Definition and main items (item info in appendix A)	Variance Explained	Reliability [b] (Alpha)	Range composite Factor score
Factor analysis on the general drivers, 4 factors extracted:				
Cost_Var	The importance of cost data and the variability of costs (items A, B, C, D)	21,96%	0.7433	-2,21 to 1,32
Syst_State	The quality of information Systems (items G, H, I)	15,58%	0.6693	-2,11 to 2,31
Complex	The perceived complexity of the hospital environment (items J, K)	14,77%	0.5217	-2,47 to 1,81
Perf_Link	Extent to which performance measures are used in hospital (items F and G)	13,58%	0.6382	-1,85 to 2,42
Factor analysis on the hospital specific elements, 4 factors extracted:				
Sat_Legal	Satisfaction with legal system and its perceived accuracy (items P, Q, R)	23,99%	0.8976	-1,62 to 3,34
Supp_Med	The importance that medical Parties attach to cost system (items M, N, O)	20,52%	0.8418	-2,00 to 2,28
Use_Legal	The extent to which legal System is used for decisions (items S, T, U)	14,80%	0.5185	-2,13 to 2,49
Conflict [c]	Level of management-physician conflict (items V, W inverted)	12,30%	0.6313	-2,62 to 2,10

PANEL B: Independent variables based on a single question

Variables	Definition
Size (contol)	The number of beds of a hospital facility
Merger(control)	Dummy for whether a hospital is involved in restructuring operations (0 for low involvement; 1 otherwise)
Reimburse (hospital)	Dummy for reimbursement scheme; 0 for prospective; 1 if it is physician cost based (retrospective)

[a] Factors extracted using the principle component analysis (rotated solution; Eigenvalues all > 1)
[b] Alpha based on the main items between brackets (Cfr. items with the highest loadings for that factor)
[c] Higher scores actually represent a more optimal relation and hence a lower level of conflict

Table 4
Summary statistics and regression results

Panel A: Average statistics of the variables (factor scores) for each cost system phase

	Phase 1 Minimum	**Phase 2 intermediate**	**Phase 3 advanced**
General			
Cost_Var	-0,28	-0,01	0,96
Syst_state	0,18	-0,20	0,19
Complex	-0,03	0,12	-0,36
Perf_link	-0,41	0,33	0,04
Hospital			
Sat_Legal	0,55	-0,41	-0,21
Supp_med	-0,49	0,23	0,74
Use_legal	0,17	-0,03	-0,46
Conflict[a]	-0,23	0,07	0,49
Reimburse (%retrospective)	55,0%	45,8%	0,0%
Control			
Size (Average No. Beds)	331	426	402
Restruct (% highly involved)	30,0%	58,3%	33,3%

[a] Note that the conflict variable uses the inverted score of item W. A higher score means less conflict as the relation with the physician is more optimal and costs are less used for financial control purposes.

Panel B: Regression results

	Ordered logistic regression[a] Three development stages		Binary logistic regression[b] Minimum level versus changers	
	Model 1	Model 2	Model 3	Model 4
Variable	Estimate (sign.)	Estimate (sign.)	Estimate (sign.)	Estimate (sign.)
Coeff_1	0.249 (.633)	-0.382 (.438)	0.854 (.440)	-0.618 (.391)
Coeff_2	2.875 (.001)***	2.016 (.001)***	/	/
General				
Cost_Var	0.588 (.019)**	0.481 (.038)**	1.023 (.102)	0.468 (.265)
Syst_state	-0.082 (.693)	-0.024 (.904)	-0.609 (.168)	-0.263 (.426)
Complex	-0.210 (.304)	-0.226 (.176)	-0.128 (.674)	-0.122 (.634)
Perf_Link	0.208 (.365)	0.116 (.592)	0.713 (.207)	0.332 (.388)
Hospital				
Sat_Legal	-0.750 (.002)***	-0.630 (.002)***	-1.619 (.009)***	-1.135 (.005)***
Supp_Med	0.738 (.003)***	0.697 (.003)***	1.108 (.038)**	0.902 (.046)**
Use_Legal	-0.287 (.193)	-0.423 (.044)**	-0.171 (.669)	-0.445 (.186)
Conflict	0.261 (.266)	0.474 (.030)**	0.582 (.178)	0.693 (.076)*
[Reimburse=1]	-1.183 (.012)**	/	-1.863 (.059)*	/
Control				
Size	4.2e-04 (.634)	4.2e-04 (.623)	1.9e-03 (.186)	9.5e-04 (.420)
[Restruct=1]	0.297 (.493)	0.271 (.512)	0.621 (.415)	0.952 (.143)
Chi-square model	41.71 (.001)***	35.10 (.001)***	40.47 (.001)***	35.46 (.001)***
Pseudo R-square	0.566	0.504	0.555	0.508

[a] dependent: Y=1 (minimum), Y=2 (intermediate), Y=3 (Advanced)
[b] dependent: Y=0 (Only a legal system, minimum); Y=1 (Changers=intermediate & advanced)
*,**,***, significant at respectively 10%, 5%, 1% level

Table A1: Item list (used in factor analyses) and summary statistics per item

Items	Percentages 1	2	3	4	5	mean	S.D.
General drivers in other industries							
Cost variability							
A. Certain care processes (DRG's), patients require more costs than others	2%	2%	22%	20%	54%	4,22	1,00
B. The indirect costs constitute a larger part of total costs	0%	10%	24%	34%	32%	3,88	0,98
Cost importance							
C. Cost information is important for staying competitive as a hospital	2%	6%	12%	27%	53%	4,24	1,01
D. Accurate cost data is crucial for our hospital	0%	0%	4%	34%	62%	4,58	0,57
Quality link							
E. Total Quality Management of our health care processes is a very important issue	0%	2%	18%	31%	49%	4,27	0,83
F. Our personal is rewarded for improving the quality of service to the customer	14%	45%	31%	6%	4%	2,41	0,94
System State							
G. Cost systems are linked to a spectrum of different performance measures	6%	33%	27%	29%	4%	2,92	1,02
H. The various IT systems (electronic patient files, inventory) are strongly integrated	16%	31%	29%	20%	4%	2,65	1,09
I. It is difficult to use our systems for defining standard activities at the patient level	2%	18%	27%	39%	12%	3,38	1,03
Perceived complexity							
J. Care process in our hospital are highly complex	0%	4%	25%	45%	24%	3,89	0,81
K. For our specific hospital it is complex to allocate cost in an accurate manner	8%	36%	28%	26%	2%	2,78	1,00
2. Organizational and behavioral items within health care							
Organizational support							
L. The board of directors strongly supports cost allocation (top management)	7%	7%	35%	39%	13%	3,46	1,03
M. The medical board strongly supports cost system use (physician)	21%	19%	47%	12%	2%	2,56	1,03
N. The physicians strongly favor the use of cost systems (physician)	26%	19%	42%	12%	2%	2,47	1,08
O. Heads of various nursing departments support cost control (nursing)	23%	21%	46%	10%	0%	2,44	0,97
Satisfaction legal system							
P. We are satisfied with the legal costing system	14%	37%	31%	16%	2%	2,55	0,99
Q. Cost drivers of the legal system allocate cost in a logical manner	12%	45%	31%	10%	2%	2,45	0,90
R. Cost calculated under the legal system quite accurately reflect the true cost	14%	51%	24%	10%	2%	2,35	0,91
Use legal system							
S. The legal system is easy to use	6%	24%	16%	39%	14%	3,34	1,17
T. The legal system is not optimal but it satisfies our decision needs	10%	33%	33%	16%	8%	2,78	1,08
U. The legal system is often used in our decisions	20%	25%	24%	24%	8%	2,75	1,25
Conflict management-physician							
V. Our relationship with our team of physicians can be described as optimal	4%	18%	22%	49%	8%	3,39	1,00
W. Cost allocation is only a necessity in managing financial relations with our physicians	37%	35%	24%	2%	2%	1,96	0,94